

US EPA ARCHIVE DOCUMENT

California's Surface Water Ambient Monitoring Program (SWAMP)

Freshwater Harmful Algal Blooms (HABs) in California and SWAMP's Statewide Assessment and Support Strategy

For assistance in accessing this document please send an email to EPACyanoHABs@epa.gov



Katharine Carter
CA North Coast Regional Water Quality Control Board
Regional HABs Program Lead

Ali Dunn & Marisa VanDyke
CA State Water Resources Control Board
Statewide HABs Program Co-Leads



Freshwater Toxins Record Breaking Years 2014 – 2016

- First time health advisories and closures for many lakes
- Extremely high toxin concentrations recorded
- Dog deaths attributed to toxins
- Multiple toxins detected simultaneously



Freshwater Toxins Record Breaking Years 2017

Quarry Lakes

Oakwood Shores near Manteca

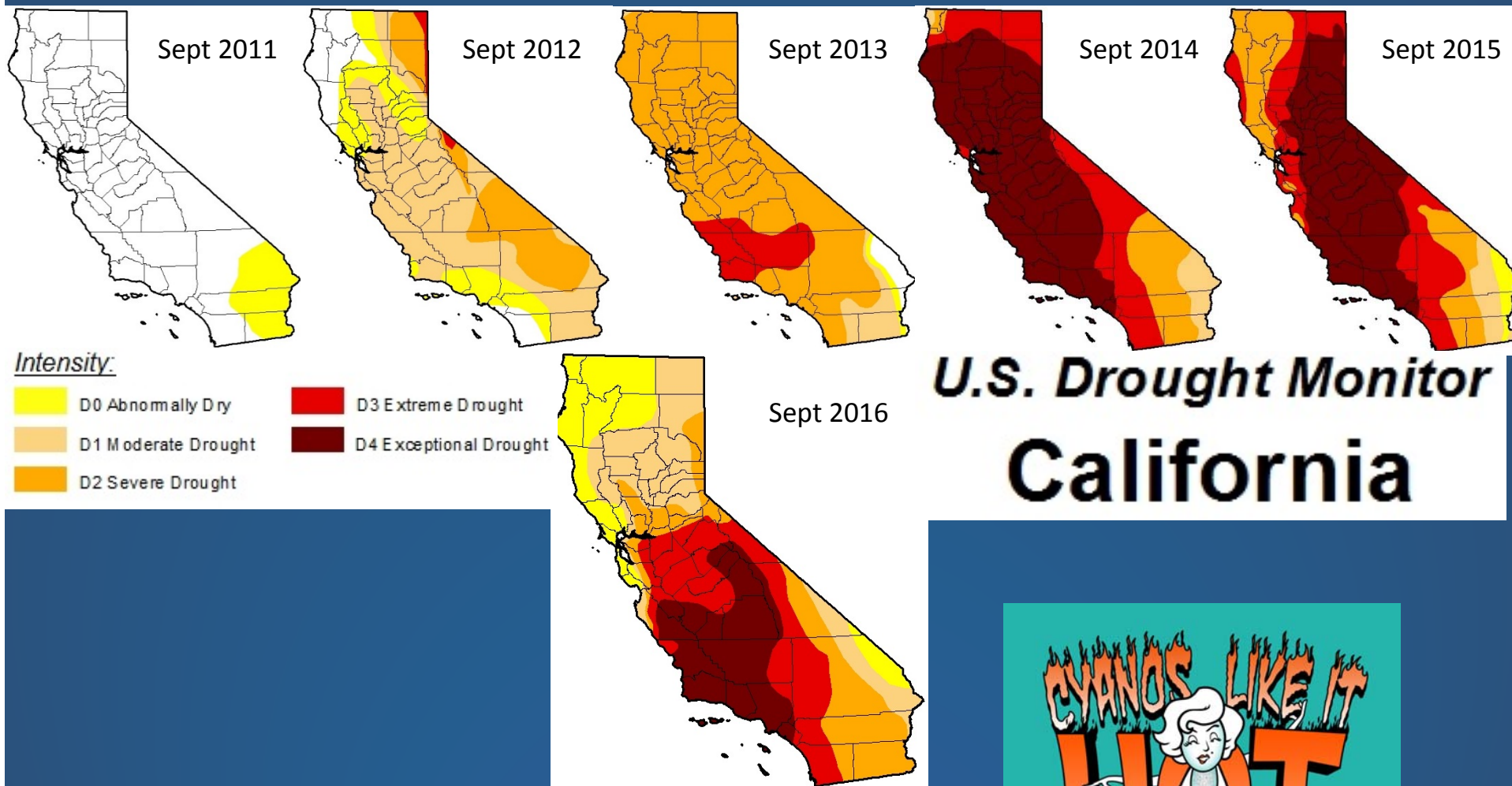
San Jacinto Wildlife Area

Salton Sea

- First time health advisories and closures for many lakes
- Extremely high toxin concentrations recorded
- Dog deaths attributed to toxins
- Multiple toxins detected simultaneously
- Already seeing blooms in 2017



Record-Breaking Drought



U.S. Drought Monitor
California

CLIMATE

Blooms Like It Hot

Hans W. Paerl¹ and Jef Huisman²

A link exists between global warming and the worldwide proliferation of harmful cyanobacterial blooms.



Paerl et al. 2009

Planktonic and Benthic HABs

Copco Reservoir



Photo Credit: KarukTribe

Pinto Lake



Photo Credit: Robert Ketley

Eel River



Photo Credit: Keith Bouma-Gregson

Russian River



Photo Credit: Rich Fadness

Early Challenges

- Unprepared to investigate blooms reports and dog deaths
 - Lack of staff training & response materials
 - Unsure who key contacts are for counties, cities, water body managers
 - Public Health officials hesitant to respond without clear guidance
- Lack of consistent message in response to media calls
- Lack of communication with the public about HABs



California Strategy

- Centralized Portal for Bloom Reporting & Information Dissemination
- Event Response Guidance
- Standard Operating Procedures for Monitoring & Sampling
- Laboratory Resources
- Education & Outreach
- Satellite Imagery for Early Bloom Detection
- Build Partnerships (CA CyanoHAB Network)



Strategic Plan – Phase 1

2016

California Freshwater Harmful Algal Blooms Assessment and Support Strategy

Beverley Anderson-Abbs
Meredith Howard
Karen Taberski
Karen Worcester

SWAMP-SP-SB-2016-0001

January 2016

http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/SWAMP/HABstrategy_phase%201.pdf

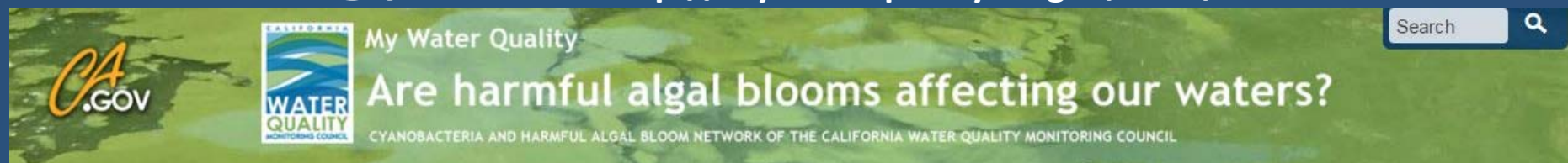


www.waterboards.ca.gov/swamp

California Strategy

Centralized Website for Bloom Reporting and Information Dissemination

<http://mywaterquality.ca.gov/habs/index.html>



Portals

About Us

Work Groups

HABs Links

California Harmful Algal Blooms (HABs)

HAB events represented below are [voluntarily reported](#) to the State Water Board's Surface Water Ambient Monitoring Program. Data provided are for general information purposes only and may contain errors. The exact location, extent and toxicity of the reported bloom may not be accurate and may not be affecting the entire waterbody. The data are subject to change as new information is received. Please check back for updates.

- [More detailed information on freshwater HAB events](#)



Toolbox

- [Report a Bloom](#)
- [Signs and Guidance for Posting](#)
- [Field Guide and Forms](#)
- [Resources for Labs](#)

News and Announcements

- [Current Advisories](#)
- [Bulletins & Newsletters](#)
- [California CyanoHAB Network](#)

Questions Answered

- [What are harmful algal blooms?](#)
 - What are harmful algae?
 - Why are they important?
 - Where do they come from?
 - Why should I be concerned?
 - What are the impacts?
 - Swimming & recreation
 - Drinking water
 - Fish & shellfish harvesting

Event Response Guidance

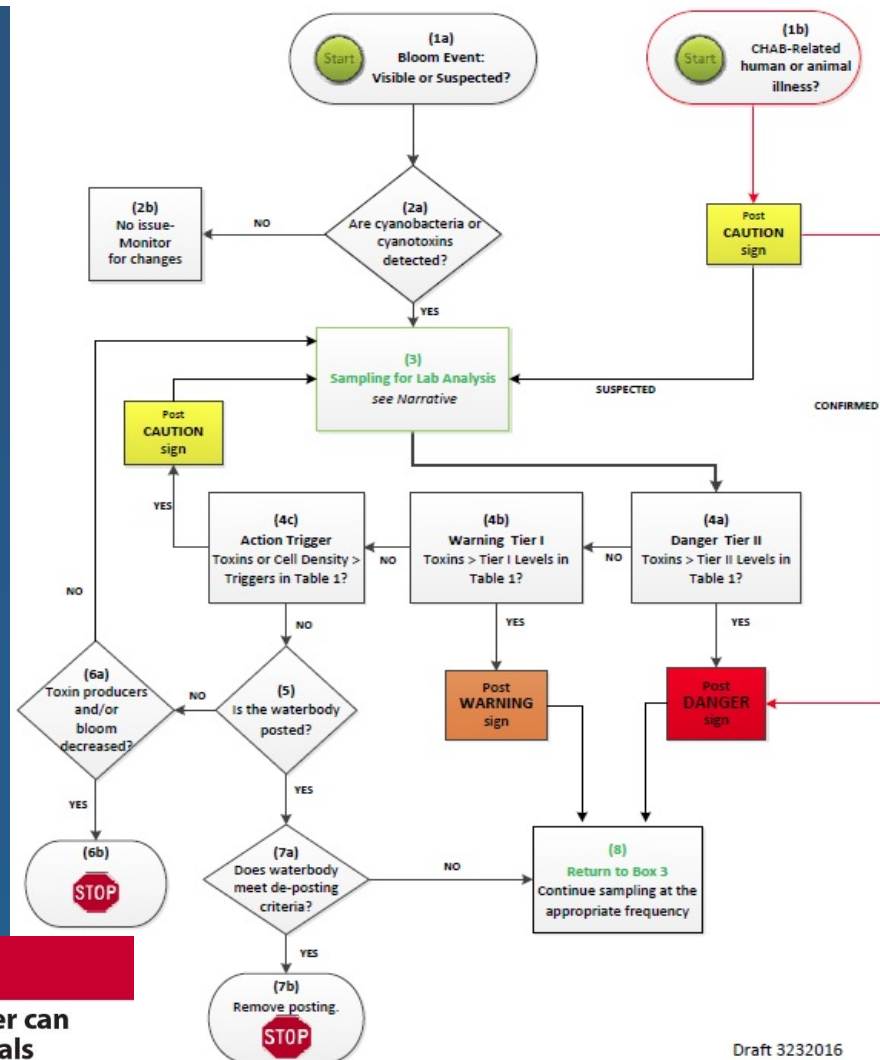
Table 1. CyanoHAB Trigger Levels for Human Health

	Caution Action Trigger	Warning TIER I	Danger TIER II
Primary Triggers^a			
Total Microcystins ^b	0.8 µg/L	6 µg/L	20 µg/L
Anatoxin-a	Detection ^c	20 µg/L	90 µg/L
Cylindrospermopsin	1 µg/L	4 µg/L	17 µg/L
Secondary Triggers			
Cell Density (<i>Toxin Producers</i>)	4,000 cells/mL	--	--
Site Specific Indicators of Cyanobacteria	Blooms, scums, mats, ect.	--	--

^a The primary triggers are met when ANY toxin exceeds criteria.

^b Microcystins refers to the sum of all measured microcystin variants. (See Box 3)

^c Must use an analytical method that detects ≤ 1µg/L Anatoxin-a.



Draft 3232016

CAUTION

Harmful algae may
For your



You can swim in this water
but **stay away from algae**
and **scum** in the water.



Keep children away
from algae in the water or
on the shore.



For fish caught here, **throw**
away guts and **clean** fillets
with tap water or bottled
water before cooking.

Call your doctor or veterinarian if:
For information on harmful algae, go to mywaterquali
For local information, contact:

WARNING

Toxins from algae
harm people and



No swimming.



Stay away from scum, and
cloudy or discolored water.



Do not use this water for
drinking or cooking.
Boiling or filtering will not
make the water safe.

For people, the toxins can cause:
• Skin rashes, eye irritation
• Diarrhea, vomiting
Call your doctor or veterinarian if you or y
For information on harmful algae, go to mywaterquali
For local information, contact:

DANGER

Toxins from algae in this water can
harm people and kill animals



Stay out of the water until further notice.
Do not touch scum in the water or on shore.



Do not let pets or other animals drink or go into the water or
go near the scum.



Do not eat fish or shellfish from this water.



Do not use this water for drinking or cooking.
Boiling or filtering will not make the water safe.

For people, the toxins can cause:
• Skin rashes, eye irritation
• Diarrhea, vomiting
For animals, the toxins can cause:
• Diarrhea, vomiting
• Convulsions and death
Call your doctor or veterinarian if you or your pet get sick after going in the water.
For information on harmful algae, go to mywaterquality.ca.gov/monitoring_council/cyanoHAB_network
For local information, contact:

Statewide Guidance for Fresh Water Harmful Algal Blooms in Recreational Waters

<http://www.mywaterquality.ca.gov/habs/resources/index.html#recreational>

California Strategy

Standard Operating Procedures for Monitoring & Sampling

<http://www.mywaterquality.ca.gov/habs/resources/field.html>

The screenshot shows the homepage of the California My Water Quality website. The header features the CA.GOV logo, the My Water Quality logo, and a search bar. The main navigation bar includes links for Home, Portals, About Us, Work Groups, and HABs Links. The content area is titled "SWAMP's California Freshwater Harmful Algal Bloom Field Guide" and includes a welcome message, a list of resources, and a table of contents. The SWAMP logo is also visible.

CA.GOV **My Water Quality** **Are harmful algal blooms affecting our waters?**
CYANOBACTERIA AND HARMFUL ALGAL BLOOM NETWORK OF THE CALIFORNIA WATER QUALITY MONITORING COUNCIL

[Home](#) [Portals](#) [About Us](#) [Work Groups](#) [HABs Links](#)

SWAMP's California Freshwater Harmful Algal Bloom Field Guide

Welcome to the California Freshwater Harmful Algal Bloom Field Guide, prepared by the Surface Water Ambient Monitoring Program (SWAMP). The goal of this manual is to provide easy-to-use, individually downloadable guidance documents, forms, and standard operating procedures (SOPs) for responding to possible harmful algal blooms (HABs). The topics covered in this field guide are listed on the side of this page for easy navigation.

- **Not sure which resources you need?**
Download our visual guide to assist you in selecting field forms and methods. ***Coming Soon***

Before Heading Out . . .

Health and Safety Guide

Protecting the health and safety of field personnel is of the utmost importance in any type of environmental sampling. Collecting samples in and around water bodies experiencing HABs has additional risks because some HABs can produce toxins, which can poison livestock and wildlife, as well as humans. Caution and safety procedures should be used to prevent direct contact with a bloom.

Field personnel should read and familiarize themselves with the information contained in this Health and Safety Guide before visiting a monitoring site.

- [Download Health and Safety Guide](#)

Site Reconnaissance SOP

Project staff should gather information about a monitoring site before and during an initial site visit. It is important to understand where the site is located, who owns and manages the land where you want to sample, and if there are any access limitations or safety issues that field personnel will encounter.

This Site Reconnaissance SOP provides procedures and helpful tips for compiling information about the site before and during a site visit.

- [Download Site Reconnaissance SOP](#)

Table of Contents

- **Before Heading Out . . .**
 - [Health and Safety Guide](#)
 - [Site Reconnaissance SOP](#)
- **Making Observations and Measurements in the Field**
 - [Field Sheet and Chain-of-Custody Forms](#)
 - [Visual Guide to Observing Blooms](#)
 - [Field Microscopes SOP](#)
 - [Field Fluorometry SOP](#)
 - [Field Toxin Detection Test Kits SOP](#)
- **Collecting Samples for Laboratory Analysis**
 - [Toxin Sample Collection SOP](#)
 - [Microscopy Sample Collection SOP](#)
 - [Fluorometry Sample Collection SOP](#)
 - [Laboratories for Analysis Guide](#)
- **Interpreting the Data & Posting Advisories**
 - [Cyanobacteria and Known Toxins Chart](#)
 - [Guide to Interpreting the Lab Report](#)
 - [HAB Incident Response and Posting Advisories Guide](#)
 - [Submitting Data to SWAMP](#)
- [Incidents of Toxin Exposure](#)
- [Glossary](#)
- [Contacts](#)

California Strategy

Standard Operating Procedures for Monitoring & Sampling

Cyanoscope



Test Strips



Field Sampling Kits



FluoroSense™ Handheld Fluorometer



California Strategy

Laboratory Resources

<http://www.mywaterquality.ca.gov/habs/resources/index.html#laboratory>

CyanoHABs Laboratory List

The purpose of this laboratory list is to readily provide information about laboratories capable of analyzing water samples for cyanobacteria and the toxins cyanobacteria can produce. This list is not intended to describe any regulatory requirements or make any laboratory endorsements. The laboratories are listed in alphabetic order. Please note – laboratories should be contacted prior to submitting any samples. Many laboratories discussed flexibility in prices and the need to coordinate any sampling and analysis. {This list was last updated September 2016}



Cyanotoxin Analysis								
Laboratory	Matrix	Cyanotoxin	Method	MDL (µg/L)	RL (µg/L)	Response Time	Sample Storage/ Shipping Condition	Shipping Preference
Beagle Bioproducts Inc. Contact: (614) 682-6588 info@beaglebioproducts.com Location: Columbus, OH	DW, AW	microcystins, total	ELISA	contact lab	contact lab	2 day response time. 24 hours response time upon request and additional fees.	Go to Beaglebioproduct.com for sampling kits & shipping containers for purchase.	Fedex overnight Samples collected over weekend should be frozen and shipped Monday.
	DW, AW	microcystins	LC-MS	contact lab	contact lab			
	DW, AW	microcystins	LC-MSMS	contact lab	contact lab			
	DW, AW	anatoxin-a	ELISA	contact lab	contact lab			
	DW, AW	cylindrospermopsin	ELISA	contact lab	contact lab		Go to beaglebioproducts.com for sampling guide and more details.	
	DW, AW	saxitoxins	ELISA	contact lab	contact lab			
	DW, AW	anatoxin-a	LC-MS	contact lab	contact lab			
	DW, AW	cylindrospermopsin	LC-MS	contact lab	contact lab			
BEND GENETICS, LLC LABORATORY Contact:(541) 600-GENE or customer_service@bendgenetics.com Location: Sacramento, CA	DW, AW	microcystins, total	ELISA	0.10	contact lab	Response time next day from sample receipt (Mon. – Thurs. delivery), and rush services (same day) can be arranged.	Frozen or on wet ice	No preference
	DW, AW	anatoxin-a	ELISA	0.10	contact lab			
	DW, AW	cylindrospermopsin	ELISA	0.04	contact lab			
	DW, AW	saxitoxins	ELISA	0.015	contact lab			
	DW, AW	domoic acid	ELISA	6	contact lab			
	Tissue (shellfish)	microcystins	ELISA	contact lab	contact lab			
	Tissue (shellfish)	saxitoxins	ELISA	0.015	contact lab			
	Tissue (shellfish)	domoic acid	ELISA	30	contact lab			
	Tissue (shellfish)	okadaic acid	ELISA	100	contact lab			
CA Animal Health and Food Safety Lab (CAHFS), UC Davis Contact: (530) 752-7578 Location: Davis, CA	Note: Lab analyzes samples related to <i>animal health</i> . The lab can analyze animal samples (tissues and stomach contents) related to possible animal exposures to cyanotoxins from harmful algal blooms.			contact lab	contact lab	contact lab	contact lab	No preference

California Strategy

Education and Outreach

<http://www.mywaterquality.ca.gov/habs/resources/index.html#informational>



Informational Presentations

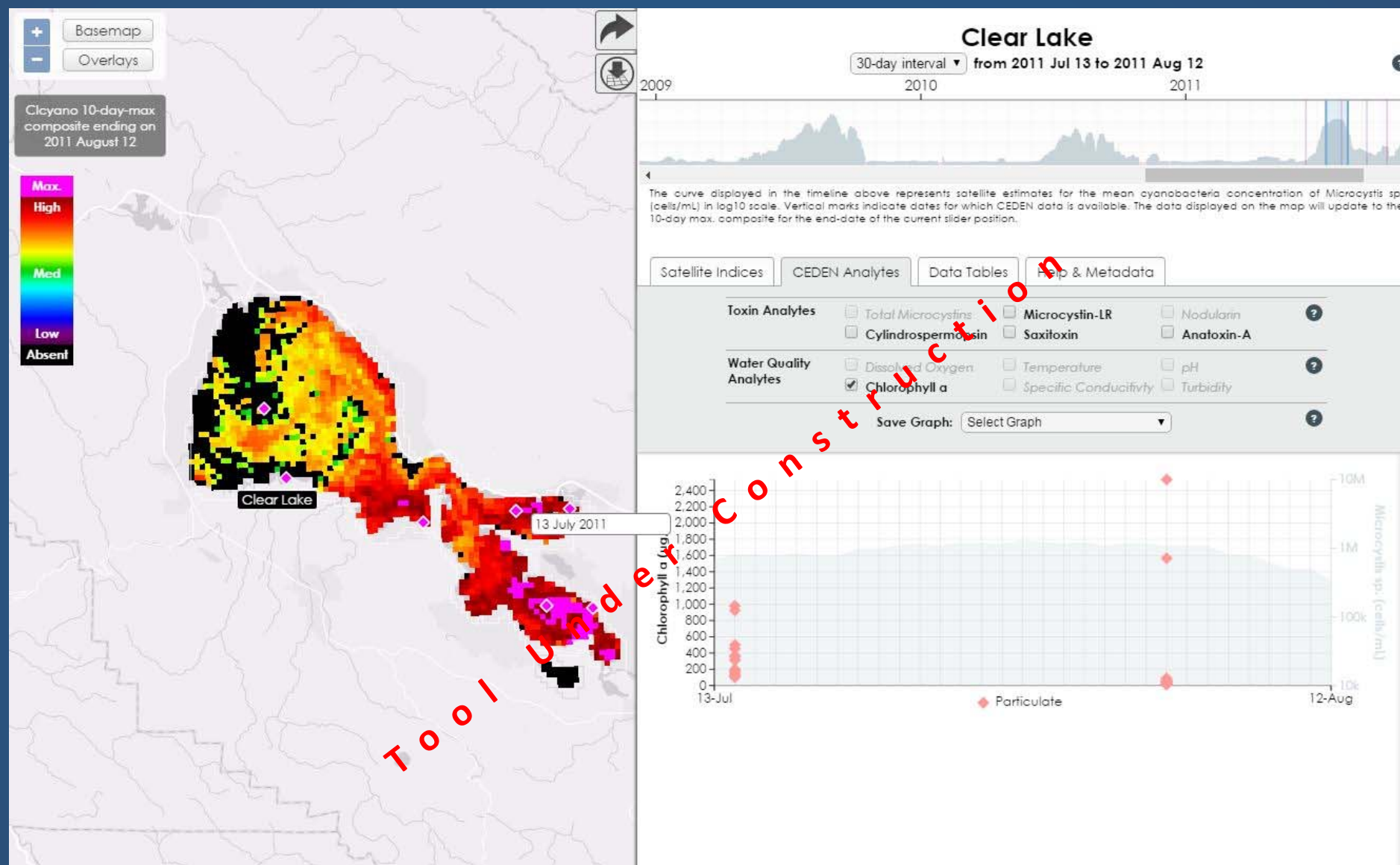
- 2016 One Day Workshop on **Identifying and Responding to Cyanobacteria Harmful Algae Waterblooms in California** - Recorded June 14, 2016 at the University of California, Davis
These lectures, organized by the State Water Resources Control Board's Training Academy and OIMA's Surface Water Ambient Monitoring Program (SWAMP) in cooperation with UC Davis Extension, were recorded and can be viewed on YouTube.
 - [HABs Workshop Video Playlist](#)
 - [Introduction: Goals of Workshop](#) 9:35
 - [Lecture 1: History and Biology of Harmful Algae Blooms \(HABs\) National and International Approaches to Detection, Management and Mitigation](#) 56:18
 - [Lecture 2: Sampling, Handling, Storage and Shipment of CyanoHABs](#) 46:09
Includes guidance on their classification as hazardous substances.
 - [Lecture 3: Cyanobacteria taxonomy, identification, enumeration and biovolume determination](#) 1:07:16
 - [Lecture 4: SWAMP Freshwater HABS Program and Resources & CCHAB Voluntary Guidance Updates](#) 52:47
 - [Lecture 5: Management and mitigation options, a ground level approach](#) 46:20
 - [Lecture 6: Lab – Identification of CyanoHABs-discussion of taxonomy keys plus some discussion/demonstration of sampling, handling and enumeration](#) 23:15
 - [2015 Lecture: An Introduction to Using Dichotomous Keys to Identify Organisms Causing Harmful Algal Blooms \(HABs\)](#) 5:08
- California Water Quality Monitoring Collaboration Network's **Cyanobacteria (Blue-green algae)**, January 2016
 - [Widespread Prevalence of Cyanobacteria & Cyanotoxins from a Variety of California Waterbodies](#) 1:09:28
 - [The California CyanoHAB Network \(CCHAB\)](#) 42:21
 - [Genetic Testing of Cyanobacteria Blooms](#) 49:27
 - [Biotoxin Gene qPCR Assay for the Aquatic Motoring and Management of Biotoxin Risk](#) 49:58
- Other Presentations
 - [CyanoHABs Field Testing Presentation](#) - May 31, 2016
 - [Western Regional Epidemiology Network](#) - May 21, 2015
 - [Monitoring and Assessment Partnership Webinar](#) - May 19, 2015



California Strategy

Satellite Imagery for Early Bloom Detection

<http://www.mywaterquality.ca.gov/habs/where/satellite.html>



California Strategy

Building Partnerships

http://mywaterquality.ca.gov/monitoring_council/cyanohab_network/index.html



- CA Cyanobacteria and Harmful Algal Bloom Network (CCHAB)
- Partnership of state, federal, and local agencies, tribes, and non-governmental organizations



- Under the overarching guidance of the California Water Quality Monitoring Council

Lessons Learned

- Prepare for response BEFORE it is necessary
 - lab analysis
 - standard operating procedures
 - responders contact list
- Press releases and talking points important
- More outreach needed
 - public education & “healthy habits”
 - treatment methods & toxin release
 - State legislature & state, county, city agencies



Lessons Learned

Must Recognize Impact of Benthic River Blooms

- Toxins present during entire sampling period (June – October)
- 3 sample methods = 3 different pictures of toxin conditions

Russian River Samples collected 9/11/16 (SPATT 8/29/16 - 9/11/16)	Microcystin (liver toxin)	Anatoxin (neurotoxin)
SPATT	3.474 ng toxin / g resin	ND
Water Grab	ND	ND
Algae Grab	0.45 ug/L	>15,750 ug/L

- High concentrations of anatoxin in algae, non-detects in water
- Low concentrations of microcystin
- Low level of planktonic cyanobacteria

Lessons Learned

- Toxi

- 3 sa

Sample
(SPAT



(October)

ditions

Solid Phase Adsorption Toxin Tracking (SPATT)

- H

- L

- Low level of planktonic cyanobacteria

water

Lessons Learned

Must Recognize Impact of Benthic River Blooms

- Toxins present during entire sampling period (June – October)
- 3 sample methods = 3 different pictures of toxin conditions

Russian River Samples collected 9/11/16 (SPATT 8/29/16 - 9/11/16)	Microcystin (liver toxin)	Anatoxin (neurotoxin)
SPATT	3.474 ng toxin / g resin	ND
Water Grab	ND	ND
Algae Grab	0.45 ug/L	>15,750 ug/L

- High concentrations of anatoxin in algae, non-detects in water
- Low concentrations of microcystin
- Low level of planktonic cyanobacteria

Lessons Learned

Must Recognize Impact of Benthic River Blooms

- Some cyanobacteria prefer fast flowing water
- Anatoxin appears to be toxin of highest concern
- Method of laboratory analysis is important (ELISA vs LCMS)
- SPATT deployment time matters



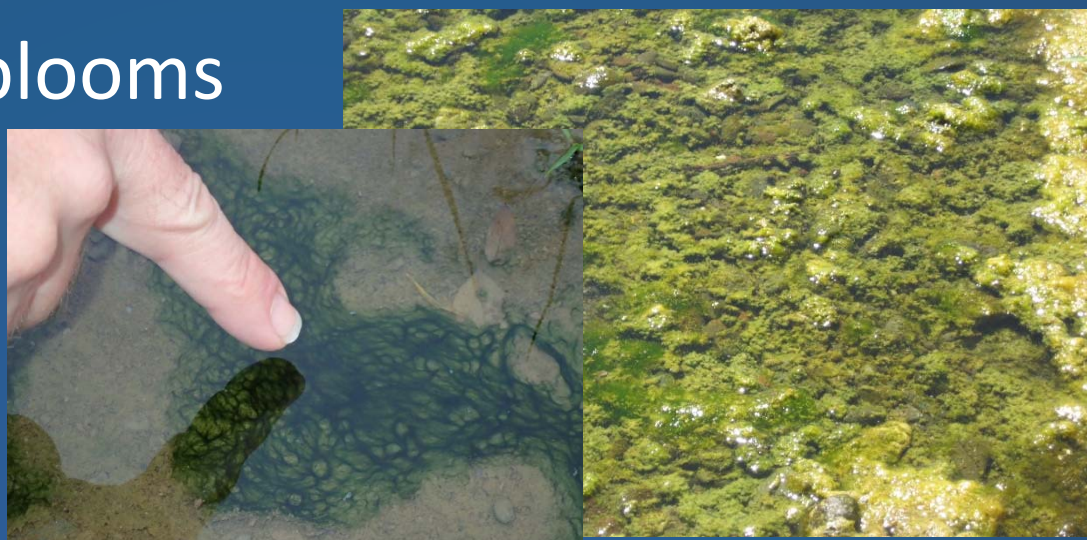
Phormidium sp.



Oscillatoria sp.

Remaining Challenges

- Lack of legislative mandate = lack of staff, funding, & authority
- Building monitoring & response partnerships takes time
- Monitoring & lab analysis is expensive
- Need to address bloom “risk factors”
- Benthic river blooms pose a new/
different
challenge



Katharine Carter
CA North Coast Regional Water Quality Control Board
Katharine.Carter@waterboards.ca.gov
707-576-2290

Ali Dunn (General Statewide Response)
CA State Water Resources Control Board
Ali.Dunn@waterboards.ca.gov
916-319-8458

Marisa VanDyke (Laboratory Methods & Analysis)
CA State Water Resources Control Board
Marisa.VanDyke@waterboards.ca.gov
916-322-8431



Clear Lake

Photo Credit: Karola Kennedy



Russian River

Photo Credit: Rich Fadness